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EXPANDED TECHNICAL ASSISTANCE PROGRAM

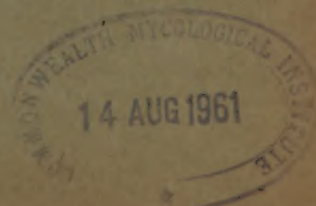
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Report to the Government
of
CEYLON
on
PLANT VIRUS DISEASE
INVESTIGATION AND CONTROL



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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REPORT

to

THE GOVERNMENT OF CEYLON

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PLANT VIRUS DISEASE INVESTIGATION AND CONTROL

By

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I. INTRODUCTION

In accordance with the terms of Supplemental Agreement No. TA-245/S/20 jointly signed on 17 October 1952 by the Government of Ceylon and the Food and Agriculture Organization of the United Nations, an FAO Plant Pathologist, Dr. William Newton, visited Ceylon to

"advise and assist the Government on the program of its Division of Plant Pathology for the control of plant virus diseases and to implement this program through such measures as

- (a) initiating and conducting a comprehensive investigation of plant virus diseases;
- (b) organizing and directing a field program for the control of these diseases; and
- (c) stimulating the adoption of new techniques for use in the control of such diseases."

The expert remained in Ceylon from 7 February to 4 December 1953.

II. ACKNOWLEDGEMENTS

The author wishes in particular to acknowledge the personal interest shown by Sir Oliver Goonetilleke, Minister of Agriculture and Food, in the progress of the virus disease investigations, and to thank Dr. A.W.R. Joachim, the Director of the Department of Agriculture, and all members of his staff who did all in their power to assist him in establishing virus disease research as an essential part of the agricultural economy of Ceylon. His special thanks are due to Dr. J.W.L. Peiris, plant pathologist, and Dr. H.E. Fernando, entomologist, the two colleagues closely associated with the virus disease investigational and control program.

III. THE PROBLEM

The officers of the Division of Plant Pathology of the Department of Agriculture had observed disease symptoms in various crops that appeared to be due to virus disease. They were eager, consequently, to obtain proof of their virus nature, information upon their economic importance, and to

find practical means of preventing their spread. One example will illustrate. In the foliage of cacao trees disease symptoms had been observed which had alarmed these officers owing to their similarity to the virus disease swollen shoot which has caused the loss of millions of trees elsewhere in the tropics. Confirmation was required that this was the identical virus to that in other tropical areas.

IV. PROGRAM OF WORK AND ACCOMPLISHMENTS

The first phase of the program of work consisted of making field surveys, with the officers of the Division of Plant Pathology, of the principal plantings of cacao, chilli, tobacco, legumes and other crops to gain information upon the distribution of suspected virus disease. The second phase consisted of setting up, at Peradeniya, of experiments designed to establish proof of the virus nature of the diseases as found. The third phase consisted of the development of plans for virus disease control and for further investigation. The results of this program of work are summarized, for individual crops, below:

Cacao: The virus nature of a disease of cacao, characterized by chlorotic vein-banding of the foliage, was established by successful graft and mealy bug transmission trials. The mealy bug transmission trials were conducted by the Division of Entomology. Field surveys showed that the distribution of the disease was very wide. Few cacao plantings, twenty years or older, were entirely free from the disease. The field distribution suggested that the disease had spread slowly outward from single infected trees, in that the number of infected trees became less, with distance, from an apparent original source of infection. Most plantings under five years old were entirely free from the disease except inter-plants among infected old trees. Such inter-plants often exhibited the disease symptoms prior to reaching the fruiting stage.

Chilli: The nature of a complex and disastrous disease of chilli, the leaf curl, was established partially by the separation of three virus components from the complex. One virus proved to be transmissible to healthy chilli seedlings by sap and by aphides. The second virus proved to be non-transmissible by sap but was transmissible to both chilli and tomato by the white fly. On tomato this component expressed itself as

top leaf curl, a very serious disease in the wet belt of Ceylon. The field evidence also suggested that this component is the cause of Storey's leaf curl in tobacco and a disease in the common weed, Ageratum conyzoides, characterized by chlorotic vein-banding of the foliage. The third virus isolated from the chilli leaf curl complex proved to be tobacco mosaic. However, the experimental evidence suggested that tobacco mosaic is a rare rather than a normal component of the chilli leaf curl complex. The insect transmission studies were conducted by the Division of Entomology.

Tobacco: The virus diseases, Storey's leaf curl and mosaic, were found to be widely distributed throughout the tobacco growing areas of Ceylon but were much more common in the Jaffna Peninsula and the other areas, where tobacco had been grown over a long period of years. Both diseases were present on the Pelwehera and Hingurakgoda Government Farms, but in these newly established tobacco growing areas the diseases had not become widespread. There is little question that the systematic removal and destruction of the few infected plants that appear on these farms would materially protect the future of tobacco growing in these areas.

The transmission of tobacco mosaic by the mealy bug, Planococcus citri, was experimentally effected. The ability of these insects to spread tobacco mosaic may account, in part, for the spread observed in a tobacco nursery owing to the abundance of mealy bug and the fact that they are carried from plant to plant by ants.

Studies were initiated of tobacco varieties hypersensitive to tobacco mosaic owing to the possibility of controlling this disease through the growing of hypersensitive varieties.

Ample field evidence was obtained that Storey's leaf curl cannot be completely controlled in areas where the weed, Ageratum conyzoides, is abundant and infected with the same virus except by the growing of immune or tolerant varieties.

Legumes: Virus diseases of legumes were found in numerous species. This is of special interest owing to the tendency of legume virus diseases to be transmitted through their seed and because of the importance of legumes for food, forage and soil improvement purposes.

The following diseases of legumes were found to be sap transmissible: Two virus diseases of dhal or pigeon pea, Cajanus cajan. The first has been

named pale mosaic because it is characterized by a light green foliage mottle. This disease spreads rapidly in the wet zones of Ceylon and is quite pathogenic. The second has been named yellow mosaic because it is characterized by a bright yellow mottle. Dhal infected with yellow mosaic was found associated with a legume weed, Phaseolus lathyroides, that was also infected with a virus disease characterized by similar foliage symptoms. Yellow mosaic appears to be confined to the dry belts of Ceylon and does not appear to spread rapidly. The disease proved to be sap transmissible to Princess beans, Psophocarpus tetragonolobus, in which it causes vein-clearing followed by a mottle. A virus disease of Crotolaria striata characterized by a conspicuous foliage mottle was found widely distributed in the wet belt of Ceylon. The disease was sap transferable to cow peas in which it caused a foliage mottle. Many other species of Crotolaria appear to be affected by the same virus.

Evidence of seed transmission was obtained with respect to the following sap transferable virus diseases: - a leaf curl disease of cluster beans, Cyamopsis psoralioides; a common foliage mosaic disease of lima beans, Phaseolus lunatus; and a comparatively rare foliage mosaic disease of cow pea, Vigna sinensis.

A virus disease was observed in dadap, Erythrina lithosperma, characterized by chlorotic vein-banding. All sap transfer trials failed to transmit the disease. The disease is of special interest in that its distribution was closely parallel to that of the vein-banding disease of cacao. The distribution correlation suggests that both diseases may be caused by the same virus.

Potatoes: Studies of potato degeneration through virus disease conducted on the Rahangala Government Farm and on nearby private farms have shown that at elevations of 4,000 feet or over, degeneration is not rapid in crops that are relatively free from aphides, but when aphides attack the crop, degeneration occurs very rapidly, chiefly through the virus disease leaf roll. This evidence indicates that successful potato production can be established in Ceylon only if the producers are supplied annually with imported northern grown certified seed potatoes, or with Ceylon seed from crops that have been certified by plant pathologists and entomologists as practically free from virus disease and aphid attack throughout the growing season.

Sweet Potatoes: A great many varieties of sweet potatoes have been found infected with a virus disease characterized by a conspicuous foliage

mottle. Ample field evidence has been obtained that this virus greatly lowers the productivity of the crop. The officers of the Plant Pathology Division are aware that only tubers and cuttings from virus free crops should be distributed for planting purposes.

Bandakka: Field studies of yellow vein mosaic of bandakka, Hibiscus esculentus, have indicated that the removal and destruction of all the diseased plants that appear early in the season is possible without greatly affecting the final crop stand by planting over double the normal number of seeds per hill. This practice has proved to be a practical means of greatly reducing the losses through the disease. Successful disease transmission trials with white fly and negative sap transmission trials have proved that the disease is identical with the disastrous disease of the same crop in India.

Grass: A virus disease was found in the common grass, Bambusa distachya, characterized by chlorotic streaks in the foliage. It was transmitted by sap to maize, Zea mays, and may be capable of infecting sugar cane.

V. RECOMMENDATIONS

Cacao: It is recommended that the experimental work in progress upon the nature, pathogenicity and the vectors of the vein-banding disease of cacao be continued. In relation to this recommendation the expert wishes to point out that virus disease in cacao has caused the loss of millions of trees elsewhere in the tropics, and highly pathogenic forms of the disease may appear at any time in Ceylon, either through chance introduction or through mutation within the form already present.

Chilli: It is recommended that the investigation upon chilli leaf curl be continued and that it be coupled with an experimental spray program designed to control the vectors of the virus components and the insects associated with the disease, particularly thrips and mites. In relation to this recommendation, it should be noted that this disease is causing at least a fifty per cent yield reduction, throughout Ceylon.

Tobacco: It is recommended that the study of tobacco varieties resistant or tolerant to tobacco mosaic be continued, for the planting of such varieties may prove to be a practical means of controlling this disease. It is also recommended that a breeding program be established designed to secure varieties that are tolerant to, or immune from, Storey's leaf curl. There is little hope of controlling this disease in the long established tobacco growing areas except through the planting of immune or tolerant varieties; this is due to the abundance of white fly, the vector, and the abundance of weeds that carry this disease.

Legumes: It is recommended that only legume seed from crops that have been certified as virus-free be distributed by Government farms. This recommendation is based upon evidence of seed transmission of the virus, upon the recognition of the growing importance of legume production in the agricultural economy of Ceylon, and upon the low cost of certification compared with the losses that inevitably follow the distribution of virus infected seed.

Potatoes: It is recommended that commercial potato production be confined to elevations of 4000 feet or over, and that the producers be supplied annually with seed tubers from crops certified as relatively free from virus disease, either imported as such, or grown in Ceylon in an area that is relatively free from aphides. This recommendation is based upon ample evidence that the planting of seed potatoes from crops that are conspicuously infected with virus, and other diseases, is always disastrous.

Sweet Potatoes: It is recommended that no tubers or cuttings from sweet potatoes be distributed from Government farms unless certified by officers of the Division of Plant Pathology as being free from virus disease.

Bandakka: It is recommended that widespread publicity be given to the practice of planting at least double the normal number of seeds of bandakka per hill to permit the removal and destruction of all plants bearing symptoms of yellow vein mosaic early in the season without greatly affecting the ultimate stand; this practice greatly lowers the losses through the disease.

Sugar Cane: It is recommended that the principal sugarcane varieties grown in Ceylon be tested for resistance to the virus diseases of grasses found in Ceylon. This recommendation is based upon the fact that virus diseases of grass usually have a wide host range and that successful sugarcane production elsewhere has been dependent upon the use of virus resistant or tolerant varieties.

General:

- (i) It is recommended that the staff of the Divisions of Plant Pathology and Entomology be strengthened to permit senior and junior officers to specialize upon virus disease investigation, and that the facilities for virus disease research be improved especially through the provision of insect proof shelters for the growing of plant species and varieties under investigation. This recommendation is based upon the importance of detecting virus disease before it becomes widespread. When virus disease becomes widespread control measures are either impossible or very costly. For example, manioc or cassava appears to be entirely free from virus disease in Ceylon. If through the appointment of well-trained virus specialists the manioc plantings can be kept free from the disastrous virus disease, cassava mosaic, so common elsewhere in the tropics; the cost of the pathologists' services would be small compared with the cost of controlling the disease should it be accidentally introduced and become widespread before being detected.
- (ii) It is recommended that a scheme of systematic crop inspections by plant pathologists be introduced as a means of preventing the spread of virus diseases, especially with respect to potatoes, sweet potatoes, legumes, cacao and chilli.
- (iii) It is recommended that the Government establish an official Plant Certification Service to certify virus freedom of material intended for propagation. The Service should be introduced in the first instance in respect of seed and propagating material distributed from Government farms and later extended to cover all propagating material of crops wherein virus disease has been found.
- (iv) It is recommended that the experimental methods established for determining immunity, tolerance or hyper-sensitivity of plants to virus disease be made an integral part of this official Plant Certification Service.

